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BAFFLING FACTS ABOUT YOUR EXHAUST SYSTEM

Over the years we have removed and installed hundreds of Luscombe style exhaust systems like the Crossover exhaust, and the dual pipes depicted in the photos that follow. The heat exchangers, or "muffs" used on the exhaust pipes often vibrate, chafe, burn, or otherwise wear out, or crack due to improper installation and inadequate maintenance of the system. This article discusses the design criteria, installation methods, the reasons for such failures, and several proposed methods to prevent such failures, saving the owner /operator hundreds if not thousands of dollars.

We will discuss the Luscombe 'dual stacks', Luscombe exhaust PN 09604 and PN 09605 equipped with standard heat muffs 486085, and 086126. The discussion is EQUALLY applicable to the Luscombe crossover exhaust used on the 8A, PN 08637, with the 48629 aluminum heater muff, though they will not be specifically referenced or photographed. The comments here ARE NOT specifically applicable to the Hanlon Wilson Exhaust system which is a far superior system design with longer life and improved design features. (Remember that the Luscombe aircraft was a cheap trainer and personal airplane designed for skinflint owners, by frugal mechanics. All the factory parts, including the exhaust system, reflect that philosophy.)

CERTIFICATION

The Luscombe was certified under CAR4, where CAR4a.6291 requires a carburetor heat rise of at least 100 degrees Fahrenheit be delivered from ambient air that is 30 degrees at 75% power in level flight. The standard Luscombe exhaust BARELY meets this standard, as is noted by the engineering comments in the original test reports. If one fails to properly install the baffles, or improperly mounts the muff to the exhaust, proper heating of the air will not occur, and the temperature rise standard will NOT be met. (By contrast, the stainless steel replacement stacks, and the Hanlon Wilson exhaust system well exceed this temperature rise due to their use of Stainless steel which has better heat transfer capabilities than the cheaper mild steel stacks.)

INSPECTION

First- remember that the Luscombe Exhaust, pursuant to service letter(s) (#4 dated 11/13/59) and FAA AD's, as well as the factory checklists, require the removal of heat muffs, and inspections of the exhaust pipes for cracks in the stacks each 25 hours of service. The constant removal for maintenance is both time consuming, and can be injurious to the muffs themselves, so I began replacing the nuts with nut plates riveted to the inboard clam shell, which assemble faster and easier. Such a change is MINOR, and allowable by the FAA as a simple hardware substitution when undertaken by your mechanic. Inspections should also include a look at the inside of the tailpipe for rust and pits, as well as a check of the stud torques and gaskets at the exhaust mounting flanges, as leaks there can damage the cylinders or warp the pipe flanges.

INSTALLATION

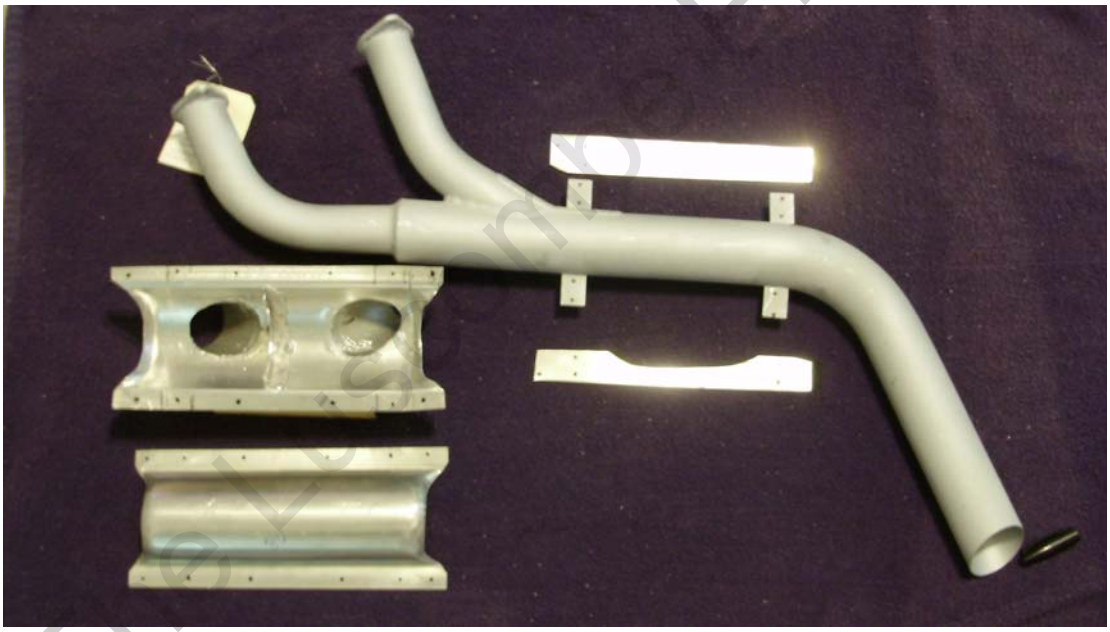
Most heat muff installations, ESPECIALLY, the carburetor heat muffs, are improperly executed in the field, because instructions from the manufacturer(s), and from the Luscombe factory, are poor, or non-existent. In the case of the aluminum heat muffs on Luscombe Exhaust stacks it is VERY IMPORTANT, that the muffs be securely mounted to the stacks, and that the internal baffles be properly positioned for maximum heating of the fresh air being heated in the muffs. Proper fastening is accomplished by first mounting the baffles to the exhaust tabs with screws and nuts.

The baffles can then provide a solid mount for the muff mounting flange at 10 or more separate points around the perimeter of the muff. The spreading of the load around the perimeter in this fashion with numerous fasteners reduces the individual loads, which in turn reduces chafing or vibration that could otherwise damage the exhaust pipes or muffs. Many installers OMIT the baffles in error, causing:

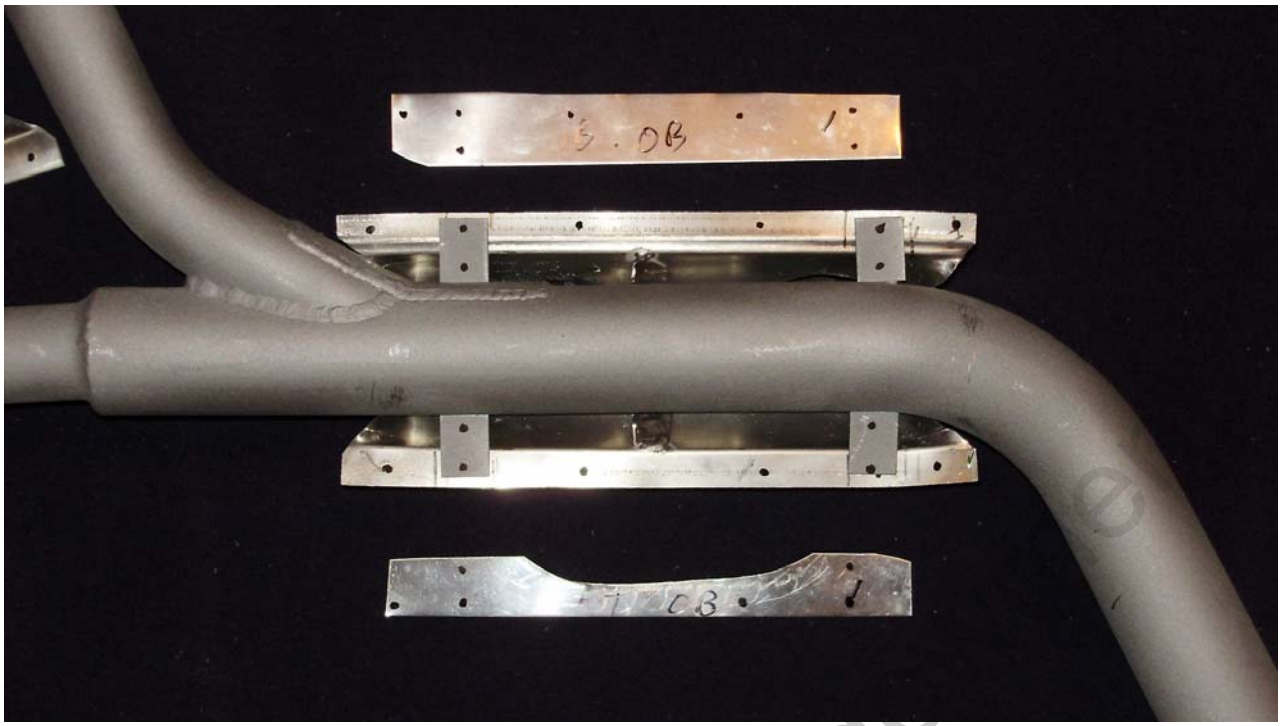
1. poor mounting conditions, vibration, and
2. Poor heating of the inbound air, and less effective heat of the cabin, or more importantly, inadequate heating of the carburetor air.

CABIN HEATER MUFF INSTALLLATION

The pictures below depict the mounting of baffles to the tabs , and the baffles to the muff flange:



Note that the welded internal chamber baffle in the inboard muff part forces the air to flow around the outside of the exhaust stack for heating before exiting the chamber at the outlet tube:



Some folks in colder climates ALSO wind small springs around the stacks to increase heat dissipation into the passing air. The baffles are used to reduce airflow speed, and to increase heat transfer into the heater airflow. Note how the baffles create a single, circuitous pathway for the air.

Baffles are trimmed to fit, then mounted to the exhaust stack tabs:

The baffles now being mounted to the tabs, those baffles are then aligned with the muff flanges, and sandwiched between the inboard and outboard muffs to provide a secure mounting of the clamshell halves to the exhaust stack:

In fitting this system up, there will be some anomalies between stacks and stack manufacturers. It is usually necessary to relieve the muff where it meets the exhaust

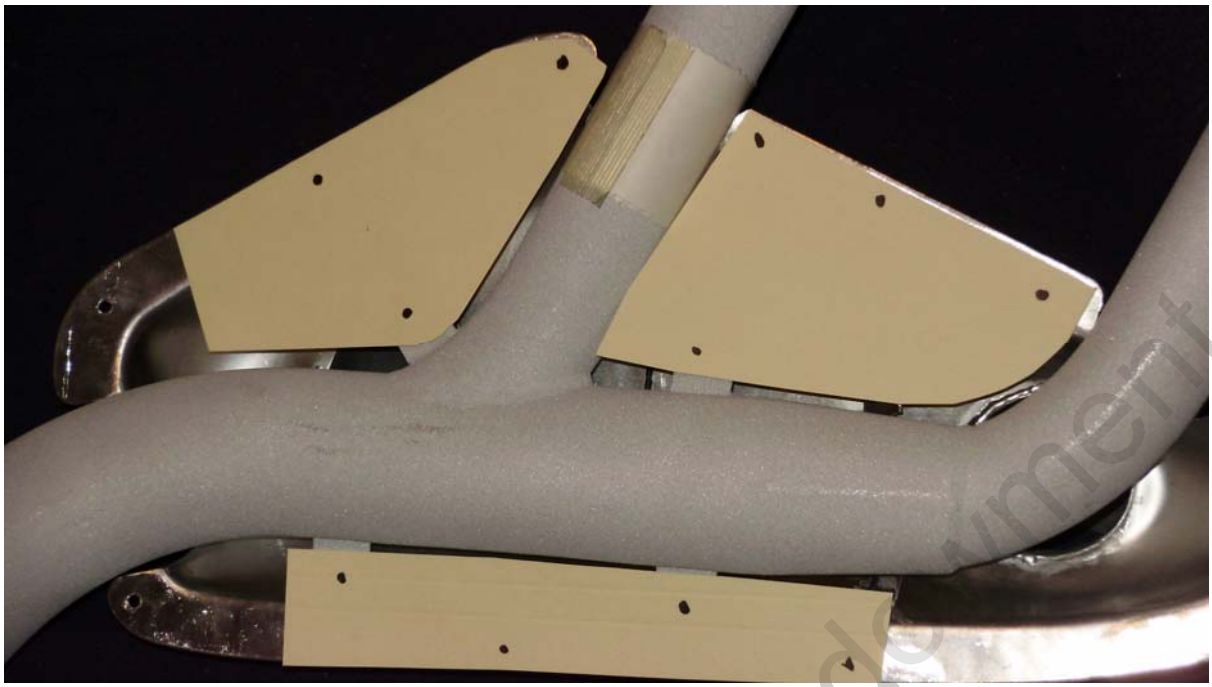
pipes so that there is about .030” to .100” clearance at the exhaust tubes and the muff. Material can be removed with a rotary file, die grinder, or with a half round file. This clearance will allow some hot air to escape, but more importantly, it provides some cooling air to the aluminum muff to keep it from melting on the hot stack.[1] Additionally such clearance prevents vibration impulses from the stack transferring into the clamshell muff causing cracks in the heat muff. Such clearance will extend the life of your heat muffs by MANY hours, and many flying seasons. Excessive clearance will reduce the heat rise and heat available to the Cabin and Carburetor. This clearance is depicted in the pictures above, and in the pictures below of the Carburetor heat muff.

CARBURETOR HEATER MUFF INSTALLATION

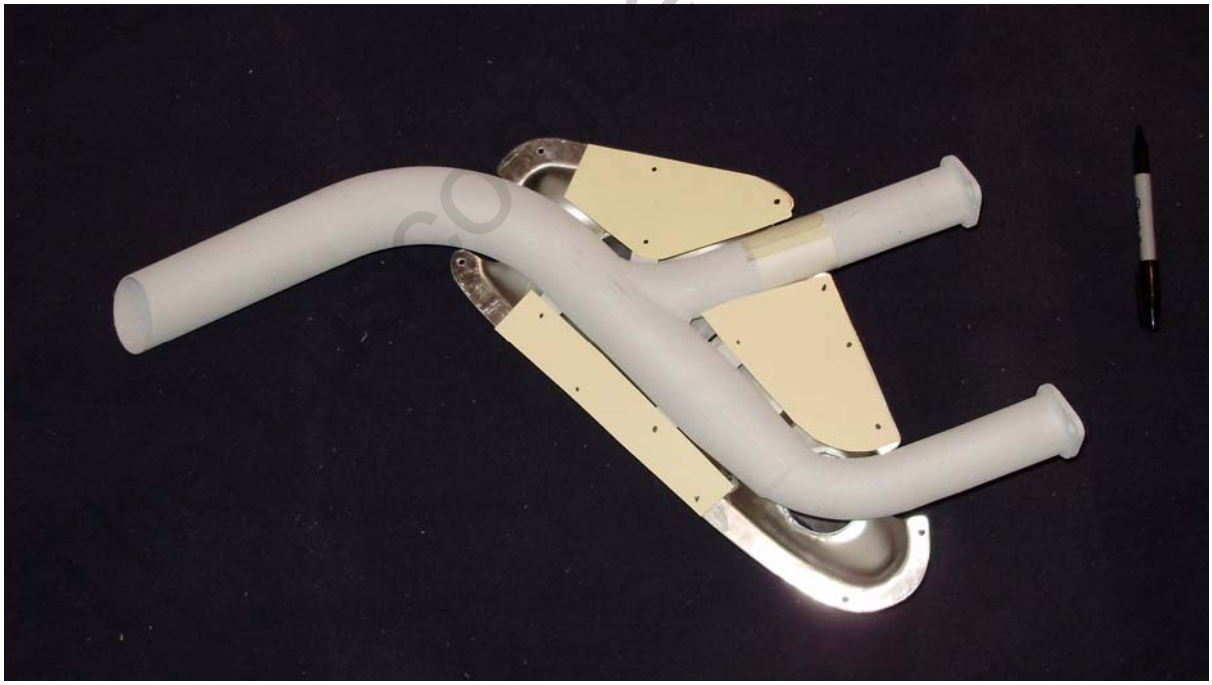
The carburetor heat muff installation is similar to the cabin heater muff, but a proper mounting of the baffles onto the tabs of the right hand exhaust is even MORE important, since the carburetor heat muff is much larger (to provide more heat), and therefore much heavier, although it is still supported by just a few tabs:

[1] Exhaust at the cylinder outlet operates at nearly 2000 degrees F. Aluminum melts at just 1000 degrees F, so cooling air flow is important, as is the reduction of the vibration imparted into the muffs. Stainless steel radiates more heat faster, so any muff contact to the exhaust tube can cause melting and damage more quickly than the mild steel exhaust if the muff is improperly fitted. If Muffs are properly fitted and supported by the internal tabs on the exhaust stacks, burning of the muff should not occur.

Baffles are trimmed to fit, then mounted to the exhaust stack tabs:



Note that the inboard carburetor heat muff clamshell has a chamber baffle that forces the air to circulate around the outside of the stacks, and to exit ONLY after a circuitous route through the muff.



With the baffles properly mounted to the stack tabs, the clamshell muff parts are then mounted to the baffles around the perimeter flange, using screws on about a 2 to 3” center:

Again, it is usually necessary to relieve the muff where it meets the exhaust pipes so that there is about .030” to .100” clearance at the exhaust tubes and the muff to allow some hot air to escape while providing some cooling air to the aluminum muff to keep it from melting on the hot stack. The clearance should look like this:

EXHAUST INSTALLATION

With the muffs securely installed to the stacks, there should be very little vibration or noise from the assembly. It can now be mounted to the cylinders using 4 brass nuts on each side of the engine. Some engine gasket kits provide two thin stainless gaskets to compress on each exhaust stud mounting area. These are approved, but often I find them less than optimum in sealing the stack to the cylinder. The use of high temp, or ultra high temp silicone sealer on such gaskets can deliver an air-tight seal where it

might not otherwise occur.[2] An even better solution to prevent exhaust leaks is to use the spiral wound blo-proof gaskets, or the Copper gaskets PN 21493. Any of these gaskets, as well as a selection of exhaust systems, and the brass exhaust nuts, are available from the Luscombe Endowment or Classic Aero by calling 480-650-0883.

As noted earlier in this article, one may install mild steel stacks, or stainless steel stacks[3], or the Stainless steel Hanlon Wilson exhaust system on the Luscombe airplanes. The additional expense of the latter two options is more than offset by the improved performance and extended longevity in service. Please feel free to call for any additional information or questions about this article.

[2] Exhaust leaks are denoted by a distinctive 'popping' or after fire when the throttle is reduced to idle. The idle mixture still flows through the engine, but lacks oxygen for complete combustion. As the rich and heated fuel mixture flows past an air /oxygen link (like a bad gasket), combustion will occur, and 'pop' or after-fire in the exhaust pipe, downstream of the exhaust valve.

[3] One may note that Univair produces aluminum carburetor heat muffs that arrive with a restriction stating that their muffs cannot be used with stainless stacks. The reason for this restriction is that they provide no proper instructions for mounting the baffles, and they deliver ill fitting baffles that will not support the stack as shown in this report. Consequently, the higher temps within the stainless system, coupled with the loose and poor fitting heater muff, allows the muffs to chafe and melt to the stacks, resulting in complaints, claims, and requests for replacements. If you or you mechanic PROPERLY mount any of the heat muffs as has been discussed and depicted in this article, no ill effects will accrue from the Stainless stacks using the aluminum muffs.